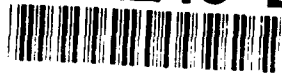


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CONTRACTING FOR ENGINEERING AND DESIGN
SERVICES IN THE ENVIRONMENTAL RESTORATION
FIELD

by

Charles S. Smith

December, 1991

Thesis Advisor:

Paul M. Carrick

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Contracting for Engineering and Design Services in the Environmental Restoration Field

by

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ABSTRACT

This thesis examines and analyzes the nature of work in the environmental restoration field. The analysis was conducted using archival and opinion research to define the unique qualities associated with the engineering and design phases of the environmental restoration process. Based on this analysis, justification for the use of cost-reimbursement contracts for the engineering services used in this field is provided. The moral hazard/incentive issue associated with cost-reimbursement contracts is then analyzed. With the moral hazard issue in mind, Naval Facilities Engineering Command's (NAVFAC) choice of the cost-plus-award-fee contract for the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract is evaluated. This evaluation looks at how the use of a long-term cost-reimbursement contract, such as CLEAN, provides incentives to overcome the moral hazard problem.



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I. INTRODUCTION

A. GENERAL

This thesis was undertaken to investigate three separate but related issues. The first is the unique nature of environmental restoration and why cost-reimbursement contracts are a valid contracting mechanism for attacking this problem. The second issue is that of moral hazard as a constraining factor on the use of a cost-reimbursement contract. Finally, the thesis considers which form of cost-reimbursement contract is best suited to counter the moral hazard/incentive issue while still solving the unique problems associated with work in environmental restoration.

B. BACKGROUND

1. The Growth of Environmental Concerns

Without question, environmental concerns have become, and will continue to become, an area of growing concern for the Department of Defense (DoD). It is only within the relatively recent past that people have developed a concern for the long term effects hazardous waste materials have on the environment. One needs only to read the daily paper to see some new outrage involving toxic contamination of some site. Public and legislative opinion has not only grown to

try to stop the contamination of the environment, it is now mandating the cleanup of all previously contaminated sites.

There was a time when the services could rely on "Sovereign Immunity" and therefore disregard many federal, state, and local regulations. While there was knowledge of toxic sites on government bases, there was little or no incentive to spend money on any type of remedial action. Several factors have drastically changed this situation. At a number of locations, runoff and seepage of toxic contamination to areas outside bases has caused great concern in the affected communities. The prospect of defense reductions, with the corresponding base closures and land turnovers, has also focused attention on the necessity for toxic site remediation.

The Superfund Amendments and Reauthorization Act of 1986 (SARA) amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (also commonly called Superfund) to make it applicable to all federal agencies, including DoD. Today there are 154 acts, 200 federal regulations, and many state regulations, all of which apply to DoD as well as civilian areas. (Griffin, 1991, p.5) The government can no longer rely on sovereign immunity when it comes to the environment and the cleanup of contaminated sites.

DoD's concern about environmental compliance has therefore increased drastically over the past several years.

Secretary of Defense Dick Cheney has stated on numerous occasions that environmental restoration is one of the top priorities within DoD. This is reflected in the Navy's Environmental, Natural and Cultural Resources Program Goals, which lists as one of it's objectives:

"Clean-up Navy shore activities at which past waste disposal practices have resulted in the potential for contamination of ground water and adverse health effects to the general population." (NEESA, 1991, pg. 4)

2. Size and Cost of Environmental Problem

It is almost unanimously agreed that the costs of environmental compliance will be staggering. By far the largest and most expensive area is the restoration of contaminated sites on DoD installations. There is currently no firm dollar value for the restoration of these contaminated sites, although some estimates are in the hundreds of billion dollars. Spending on the Defense Environmental Restoration Program (DERP) has increased 600 percent since it was established in 1984. From an initial budget of \$159 million, DERP funding reached \$1.1 billion in 1991, with over \$1.3 billion proposed in the 1992 budget. (Ichniowski, April 1, 1991, pg. 26)

Many experts point out that this is only the tip of the iceberg. The Defense Department recently added 3000 new military base sites to the toxic cleanup list. This

represents a 21 percent increase and brings the total number of contaminated sites to 17,482 on 1,855 military installations. (Ichniowski, April 1, 1991, pg. 26) Gary Cohen, with the Boston-based National Toxic Campaign Fund, is not sure even this new figure accurately reflects the size of the actual problem. As he states;

"the problem is even worse than we imagined... virtually every major base, and many minor ones, have serious contamination problems." (The Washington Post, March 29, 1991, pg. A8)

The problem of environmental restoration on such a huge scale is not a simple one. The answer is not simply, as many environmentalists propose, throwing huge amounts of money at the problem. This is especially true in light of the current and projected decline in the DoD budget. As Representative Richard Ray, Chairman of the Environmental Restoration Panel of the House Armed Services Committee, says, "DoD needs a balanced approach to waste cleanup and minimization." (Ray, 1990, pg. 11) He suggests an approach using common sense, fiscal responsibility, and accountability for the cleanup of environmental problems generated over the past 50 years.

Given the dollars involved and the political sensitivity of environmental restoration, it should be obvious that an extremely effective plan of attack is needed. This

thesis will provide the justification and insight needed to make sound decisions concerning that plan.

3. Environmental Regulations

As stated earlier, in 1986 SARA amended CERCLA to cover all federal agencies, including DoD. CERCLA regulates both the cleanup of hazardous waste sites and all releases of hazardous substances into the environment. (Both past and present.) The regulation which actually implements the statutory requirements of CERCLA is 40 CFR 300, National Oil and Hazardous Substances Pollution Contingency Plan, more commonly referred to as the National Contingency Plan (NCP). The Environmental Protection Agency (EPA) is responsible for implementing all CERCLA provisions.

Hazardous substances are defined by the Clean Water Act (CWA) and CERCLA as chemicals which are harmful to aquatic life or the environment. CERCLA regulates the cleanup of these substances if more than the reportable quantities, as defined by EPA, are spilled or otherwise released into the environment.

The Resource Conservation and Recovery Act (RCRA) of 1976, defines hazardous wastes based on levels of reactivity, ignitability, corrosivity, or toxicity. RCRA, however, is concerned only with the day-to-day management and disposal of these wastes. CERCLA regulates the cleanup when they have been dumped or spilled in the environment.

4. Environmental Restoration Process

Environmental restoration consists of the identification, investigation, design of a plan of action, and the actual cleanup of contaminated sites. The nature of the exact contamination is not important for purposes of this thesis. The contamination could be due to any of the hazardous wastes or hazardous substances defined by CERCLA. The site could be the result of years of dumping, underground migration from a leaking tank, or a recent spill. This thesis is only concerned with the fact that a site is contaminated and needs to be cleaned up.

Environmental restoration encompasses much more than the actual physical cleanup of a contaminated site. In fact, the cleanup itself is often the simplest and quickest part of the process. The larger problem is defining the scope of work, designing a cleanup procedure, and getting the design through the regulatory process. The time required to get a project from discovery of the site, to design approval, can be anywhere from four to six years. (Rispoli, 1991, pg. 45) This thesis will be limited to the design and regulatory portion of the environmental restoration process because this is where cost-plus contracts are most appropriate.

DoD manages environmental restoration through its Installation Restoration Program (IRP or IR Program). The IRP was established in 1984 as a comprehensive program to help

identify, investigate, and cleanup contaminated sites on DoD installations. The program consists of the following seven steps:

a. Site Discovery

A Commanding Officer (CO) must immediately notify the National Response Center (NRC)¹ when he becomes aware of a hazardous substance spill. This CERCLA reporting requirement does not distinguish between an accidental spill and a dump site which has existed for years, and is suddenly found to contain hazardous substances. Under site discovery, the CO is also required to review installation records to uncover existing toxic sites which have not been reported. Notification requirements are not fully met until the CO forwards a Preliminary Assessment/Site Inspection (PA/SI) report to the EPA and state regulatory agencies.

b. Preliminary Assessment/Site Inspection (PA/SI)

The goal of the PA/SI is to identify potential hazardous waste sites. The PA is the initial step. It is developed from readily available existing information which details installation activities and land uses. It should include (1) identification of the source and nature of a release, (2) an estimate of the magnitude of the potential threat, and (3) a discussion on what will be needed to

¹NRC's are communication centers connecting activities related to hazardous waste releases or response actions.

determine if immediate removal is necessary. (CNO, 1988, pg.

5) The PA will also include a statement about whether additional investigation is required.

If additional investigation is required, a site inspection (SI) will be conducted. The SI will consist of a site visit during which limited samples will be taken. These samples will be analyzed to verify the findings of the PA. The entire PA/SI report is then sent to the EPA and state regulatory agencies.

Information from the PA/SI report is used by the EPA to rank the site under a Hazard Ranking System (HRS). The hazard ranking system uses a mathematical model to score hazardous waste sites based on the potential risks the contaminants present to people and the environment. Sites receiving a score of 28.5 or higher are placed on the National Priorities List (NPL), where they will receive the highest priority within the Installation Restoration Program.

c. Coordination With Regulatory Agencies and the Public

Once the initial investigation has been completed, CERCLA requires that all regulatory agencies and the public be given the opportunity to review and comment on the results of any assessment or study. This is important because CERCLA now allows any citizen to sue any federal agency which "...is alleged to be in violation of any standard, regulation,

condition, requirement, or order" enacted under CERCLA. (CNO, 1988, pg. 9) The government can have these lawsuits dismissed if it acts to comply with the CERCLA requirement in question within 60 days of being notified of the suit. This aspect of CERCLA highlights the political environment in which DoD is operating. Coordination with regulatory agencies and the public is a continual and critical requirement throughout the restoration process.

d. Remedial Investigation/Feasibility Study (RI/FS)

Sites which are identified in the PA/SI as posing potential threats to humans or the environment require further investigation and study. A Remedial Investigation (RI) will then be conducted to determine the nature and extent of contamination at the site. Detailed water, soil, and air samples are taken to define the exact contaminants, their concentrations, and their migration path. The RI also includes a health assessment to evaluate possible risks to the public and the environment.

Based on data collected during the RI, a feasibility study (FS) evaluates potential remedial alternatives based on effectiveness and cost. Protection of public health and the environment will be paramount with any option considered, however.

e. Record of Decision (ROD)

A Record of Decision (ROD) must be prepared to document the cleanup option selected and the justification and rationale behind it. The ROD must be made available to the public for comment and criticism. Public concerns must be responded to prior to any further remedial action.

f. Remedial Design

Once the most appropriate cleanup method is selected and approved, a design is drawn up. This will provide the job specific procedures and requirements based on the cleanup procedure selected and the actual site conditions.

g. Remedial Action

The remedial design will stipulate the job specific procedures to be used during the actual cleanup. The type of contract used will depend on the exactness of the specifications and the amount of uncertainty which still surrounds the work. For sites on the NPL, CERCLA requires that the remedial work commence within 15 months of completion of the ROD.

It should be obvious from the steps described above that there is much more involved in environmental restoration than simply contracting for the actual cleanup. Fulfilling the requirements of the regulatory process, from site discovery through the design phase, typically takes from four

to six years. This process takes so long because there is extensive regulatory involvement at each step. Every investigation, plan, study, and design is reviewed. A regulatory agency, either federal, state, or local, can reject any of these submissions if it does not satisfy their own requirements or regulations. Approval to move to the next phase is not given until all regulatory agencies have approved the documents required in the preceding step.

5. Comprehensive Long-Term Environmental Action Navy (CLEAN)

The cost-plus-award-fee contract is one of five types of cost-reimbursement contracts. Naval Facilities Engineering Command (NAVFAC) made the decision several years ago to use cost-plus-award-fee contracts to attack the Navy's environmental restoration problem. The actual contract NAVFAC has developed for this problem is the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract.

The CLEAN contract purchases engineering services from discovery through the design phase of the restoration process. Because the CLEAN contractor is selected using Brooks Act provisions², he is limited to providing engineering services

²The Brooks Architect-Engineers Act of 1949 was established to allow the government freedom in selecting engineering services. Engineering services can be contracted for on the basis of technical competence without having to go through a competitive bidding process requiring mandatory selection of the lowest bidder.

and can not perform any of the actual cleanup. There are, however, provisions which allow the CLEAN contractor to perform interim remediation in emergency situations.

The CLEAN contractor performs almost all of the functions needed to ensure the Navy stays in compliance with all federal, state, and local environmental laws. This includes, but is certainly not limited to, conducting the assessments, studies, and investigations previously described; preparing environmental permits; preparing environmental planning documents; performing field and laboratory tests; coordinating with regulatory agencies; and preparing remedial designs. (NAVFAC, 1990, pg. 2) The special provisions mentioned earlier also allow the contractor to perform emergency spill response and cleanup.

CLEAN contracts have been awarded, or are about to be awarded, at all six of the Navy's Engineering Field Divisions (EFD). Each has a performance period of one base year plus nine option years. Based on the contractor's performance, the Navy will decide at the end of each year whether the next option year should be exercised. Each of the CLEAN contracts has an estimated value of between \$100 and \$130 million. (Rispoli, 1991, pg. 45) The amount of funding authorized demonstrates the huge dimension of this problem.

C. METHODOLOGY

This thesis was conducted using archival and opinion research to define the environmental problem, validate the use of cost-reimbursement contracts in the environmental area, and investigate the moral hazard associated with cost-type contracts. No statistical, survey, or numerical data is used.

D. SCOPE AND LIMITATIONS

The engineering, design, and regulatory portion of environmental restoration covered by CLEAN contracts is the longest phase of the work, and is an area highly susceptible to scope and price uncertainties. This makes it an ideal area for evaluating the utility of the cost-plus contract.

Even though NAVFAC has shifted to the use of cost-reimbursement contracts for the engineering and design work required in the environmental area, there is no single comprehensive justification for this shift. This thesis will provide that single source justification. It will investigate the two basic types of contracts, firm-fixed-price and cost-reimbursement, to determine which is better suited for this work.

The unique nature of environmental design work will be investigated to explain why traditional NAVFAC contracting mechanisms are not always suitable for environmental restoration. Other contracting mechanisms (indefinite quantity, and time and material contracts) are still available

to NAVFAC in the environmental restoration area. However, difficulties quantifying the effort required in environmental work, particularly in the engineering and design area, have required a shift in emphasis to cost-reimbursement contracts. Also, these other contracts represent only a small percentage of contracts, are limited to specific situations, and fall into the two broad categories of contracts which will be investigated.

The moral hazard/incentive problem inherent in cost-reimbursement contracts will also be investigated. Each of the five different type cost-reimbursement contracts will be studied to determine which is best suited for controlling the moral hazard problem. Beyond the justification for a cost-reimbursement contract, this analysis will provide specific justification for NAVFAC's use of a cost-plus-award-fee contract for the CLEAN.

II. CONTRACT TYPES

A. CONTRACTS AND RISK

A contract is a legal agreement between two parties. It stipulates that one party will provide some product or service to the other party for some form of compensation. A goal of any contract is improve the utility of each party. Another goal, for each party, will be to effect the transaction at the lowest ultimate cost. For the party writing the contract, the lowest ultimate cost will include both the actual cost of the product or service and the cost of writing and administering the contract. For the contractor, the lowest ultimate cost will be a combination of the risk he will assume and the expected cost of the work. The type of contract and terms of the contract are subject to negotiation between the parties before it is signed. Both the type and terms of the contract are determined by the nature of the endeavor being undertaken and the risks associated with successful completion.

Risk, and who bears what portion of the risk, is a crucial issue in negotiating a contract. Risk can be defined as the possibility of suffering harm or loss due to the stochastic character of the product to be delivered or the conditions defining delivery. There is always the risk that uncertainties in the form of difficulties or events will occur

during the performance of the contract which were not foreseen at the time of contracting.

Specifically, this thesis will deal with events and conditions which result in cost risk of performance. This is the risk that the contract work will cost more than the amount agreed to when the contract was signed. Cost risk is caused by the uncertainties inherent in estimating the cost of contract work. The final cost of the contract will directly determine the profit, or loss, which the contractor experiences. Cost risk is important because it is related to this final profit or loss, and one of the fundamental business motivations is to maximize profits.

The cost risk of performance affects contracts in two ways. First, the more cost risk the contractor takes on, the more cost-conscious he should be. Secondly, however, it can be said that defense contractors are basically risk averse. (Pitts, 1968, p. 94) This means they will avoid risk unless they are compensated for accepting it. This compensation will have to exceed the expected payoff to entice the risk averter into accepting the risk.

A risk averter is an individual whose utility function is concave. This means that the marginal utility of money declines over the entire relevant range. (Diminishing marginal utility) Put another way, the risk averter would prefer a perfectly certain investment over an equal, but less certain, return. Before a risk averter will accept risk, such

as cost risk of performance, he must be given a risk premium to compensate for the loss of utility due to the risk itself. The amount of the risk premium will depend on the individual's utility function. (Levy and Sarnat, 1982, pp. 205-209) The risk averter will typically not accept risk without both some limit on loss and acceptable levels of anticipated compensation.

B. CONTRACT TYPES

Government contracts fall in one of two broad categories as defined by the Federal Acquisition Regulations (FAR) Part 16. They are firm-fixed-price (FFP) and cost-reimbursement contracts. The basic difference between a FFP and cost-reimbursement contract is the degree to which responsibility is assumed by the contractor for the cost of performance. Another way of stating this is: who does the cost risk of performance rest with?

1. Firm-Fixed-Price Contracts (FFP)

With the FFP contract, the price is set up front, usually by use of a competitive sealed bidding process. The contractor agrees to provide a product or service for the fixed price. If the contractor fails to provide this product or service, he is not entitled to payment. (The government must always pay for any value it has received, however.)

Since the price is fixed prior to the start of work, the cost risk of performance and the resulting profit (or

loss), are the responsibility of the contractor. If costs run higher than anticipated, profit will decrease, or there could be a loss. Conversely, if costs run less than expected, the contractor's profit will increase. In this way, the FFP contract places the maximum cost risk on the contractor.

A contractor will accept a FFP contract because, based on the statement of work and the contract specifications which describe exactly what is required, he should be able to accurately estimate his own costs for performing the work. If anything arises after contract award which is not included in the contract, a modification must be processed compensating the contractor for the additional work. The contractor's cost risk is thereby limited to only those items which were specifically spelled out in the contract.

Because the scope and responsibilities are specifically defined in a FFP contract, contractors can measure the risk they will be assuming. The contractor can therefore submit his bid weighing the profit he would like to receive against the competitive environment of the sealed bidding process. When a contractor's bid is accepted by the government, usually because it is the lowest, the contractor is committed to that price. His profit will depend on how well he manages his own costs. The FFP contract should therefor provide the greatest incentive for efficient and economical performance by the contractor.

a. When To Use Firm-Fixed-Price Contracts

Because of the cost risk placed on the contractor, the government has to be sensitive to how and when the FFP contract is used. It should be limited to situations where well defined specifications are available, where costs can be fairly accurately estimated, and where the risks are minimal or can be estimated with some degree of certainty. (FAR Part 16, 1989, p. 16-1)

2. Cost-Reimbursement Contracts

Cost-reimbursement (also called cost-plus and cost-type) contracts transfer the cost risk of performance from the contractor to the government. They do this by providing that the contractor be paid for all reasonable, allocable, and allowable costs incurred, up to the funding limit, while trying to perform the contract work. The funding limit is based on the estimated cost of the product or service, which is agreed to prior to the start of work.

There is no obligation on the contractor's part to actually produce a product or provide a service. He agrees only to use his best effort in an attempt to provide these things. He will work toward this goal until the government directs him to stop, or he reaches the pre-established funding limit.

If the contractor has not fulfilled the requirements of the contract when the obligated funds have been spent, he

is required, by law, to stop work. At that time, the government can either end the project or authorize additional funds.

It is in this way that the government assumes the entire cost risk of performance under a cost-type contract. The contractor is guaranteed he will be paid for the work he performs, regardless of whether anything is actually provided. At the same time, the government is committed to paying all contractor expenses regardless of whether it actually receives any benefit.

a. When To Use Cost-Reimbursement Contracts

Because the entire cost risk of performance rests with the government, cost-reimbursement contracts should be used only after careful study has determined they are appropriate for a given situation. They are very useful, and in fact necessary, in situations where there are major uncertainties involved in the work which make it impossible, or overly expensive, for a contractor to provide a fixed-price for the work. Typically, a cost-reimbursement contract will be used when there is a relatively broad statement of work and there is a desire for the contractor to be both creative and flexible in attacking the problem. (Administration of Cost-Reimbursement Contracts, 1991, p. 1-1) In these situations, the government must assume the cost risk of performance by using some form of cost-reimbursement contract.

b. Restrictions on Cost-reimbursement Contracts

Anytime a contractor works without cost risk there should be a concern about lack of incentive to control costs. This is understandable in that the contractor will suffer no ill effects if costs are not kept under control and the job overruns. This is at the heart of the moral hazard/incentive issue which will be discussed in the next chapter. Concerns about this issue have resulted in FAR restrictions on the use of cost-reimbursement contracts. FAR Part 16.301-3 limits the use of cost-reimbursement contracts to situations where:

- a. The contractor's accounting system is adequate for determining what costs are applicable to the contract;
- b. Sufficient government surveillance is available during performance to ensure efficient and effective cost control measures are used; and
- c. A Determination and Finding has been conducted showing that (1) the cost-reimbursement contract will likely be less expensive than any other type contract, or (2) it is impractical to obtain the product or service required without the use of a cost-reimbursement contract.

These limitations are placed on the use of cost-reimbursement contracts to ensure that they are only used when necessary, and only when conditions are such that the government has the ability to monitor the contractor to help ensure efficiency.

III. MORAL HAZARD

A. CONCERNS WITH COST-REIMBURSEMENT CONTRACTS

There is a general mistrust of cost-type contracts within NAVFAC. This mistrust is not entirely without merit. There is a genuine concern about efficient and effective use of limited funds when using a contract that places the cost risk of performance squarely on the government. It is also understandable that there would be a certain amount of apprehension with any contract under which stupidity, ignorance, incompetence, and possibly even deceit are all reimbursable.

The concern with cost-reimbursement contracts is that the contract creates mixed and possibly conflicting incentives for the contractor. Under a basic cost-reimbursement contract the contractor is assured payment for all allowable and allocable costs he incurs. This includes mistakes and miscalculations made by the contractor. Unless the government can prove fraud or willful misconduct, the contractor will be paid for the work he does, regardless of whether the government actually receives any product, service, or value. Thus, a contractor may not be solely motivated to perform the work in an economical and cost efficient manner.

These concerns are a special case of a quite general economic issue: the principal-agent problem. This is the problem of economic incentives, information availability, and absence of control by the principal. The problem centers around how one party, the principal, can design a contract (compensation system) which motivates another party, the agent, to act in the principal's interests. (The New Palgrave, 1987, p. 966) This problem cannot be avoided because it is associated with work that is usually too complicated or too costly for the principal to perform himself. He must therefore hire an agent with specialized skills or knowledge to perform the work. (Sappington, 1991, p. 45) The principal, however, is then dependent on the actions of the agent, who has a great deal more knowledge and information about the area in question.

The principal-agent problem manifests itself because the principal must rely on the actions of the agent, but he has imperfect information and therefore does not know exactly what action the agent has taken, or should take in a particular situation. Because the agent is trying to maximize his own pay-off, his actions will often not be the same as those which would be preferred by the principal. Because of the information asymmetry and the fact the agent is trying to maximize his own utility, there is an incentive for him to act opportunistically. The actions he takes will be in his own

interest, and not those of the principal. This is how the principal-agent problem boils down to an economic incentive problem.

The information asymmetry is compounded by the fact that the actions of the agent, or the information on which his actions are based, are often difficult to observe. A possible remedy for this problem is to monitor the actions of the agent, use this information to evaluate his performance, and tie his reward to his performance. This should penalize dysfunctional behavior. The problem with this solution is that full monitoring of the contractor is either impossible or prohibitively costly. (Holmstrom, 1979, p. 74) Even when full monitoring of the agent is feasible, the information asymmetry often means that the principal does not know whether the action was appropriate or in his best interest. (The New Palgrave, 1987, pp. 966-971)

The problem then becomes one of trying to design a contract which will motivate the agent to act in the interest of the principal. The motivation is provided by the use of incentives placed in the contract. This can be a difficult problem considering the nature of a cost-reimbursement contract; the contractor is not held responsible for successful completion of the work, yet he is paid for all costs he incurs.

B. MORAL HAZARD

The principal-agent problem is often referred to as the moral hazard problem. (The New Palgrave, 1987, pp. 967) The New Palgrave, A Dictionary of Economics, defines moral hazard as;

"..actions of economic agents in maximizing their own utility to the detriment of others, in situations where they do not bear the full consequences or, equivalently, do not enjoy the full benefits of their actions due to uncertainty and incomplete or restricted contracts which prevent the assignment of full damages (benefits) to the agent responsible" (The New Palgrave, 1987, p. 549)

This definition describes the classic case of moral hazard in an insurance contract. Once an individual (agent) is insured, there is a danger his actions will not reflect the best interests of the insurer (principal). As an example, a homeowner who purchases theft insurance may become less careful about locking his doors at night. This is because he is economically protected by the insurance. The Palgrave definition accurately reflects the situation when the government (principal) hires a contractor (agent) to perform work under a cost-reimbursement contract. Because of the risk sharing considerations discussed earlier, the cost-reimbursement contract is used to protect the contractor from financial loss due to uncertainties inherent in environmental work. This can be viewed as economic insurance for the contractor. The danger is that once the contractor is protected from the cost risks of a contract he will have little or no incentive to control costs. The contractor will

also be less likely to disclose information or make unbiased reports to the principal about matters which might affect his reward. It is impossible to insulate the contractor from the cost risks caused by uncertainties without also protecting him from the consequences of their own actions. (The New Palgrave, 1987, p.549)

What this means is that the government must find a way to motivate the contractor to perform as they would themselves if they were doing the work. The different types of cost-reimbursement contracts will be discussed and evaluated as to their effectiveness in providing motivation, or incentives, to the contractor so that he will act in the desired manner.

C. MORAL HAZARD IN THE ENVIRONMENTAL FIELD

The nature of environmental restoration lends itself to the moral hazard, or principal-agent, problem which was described above. There is imperfect information about what will be required on any particular job. (This issue will be addressed more fully in the next chapter.) There is also a great deal of information asymmetry between the contractor and the government. This is not in itself bad, and in fact is the reason the contractor was selected; the government did not have the knowledge or expertise to do the work itself. This fact, however, means that the contractor will have information about the site, and the extent of the cleanup, which the government will not necessarily be aware of. This information

can affect all aspects of the remediation process, from the extent and cost of the cleanup to the liability for the work once it is complete.

Chapter IV will discuss the nature of environmental restoration and which type of contract is best suited to handle this problem. The moral hazard issue is one which cannot be ignored in this analysis. In light of the information asymmetry, how will the different contract types motivate the contractor? Would a FFP contract encourage the contractor to point out additional cleanup requirements discovered during his testing? How would the contractor be motivated in a similar situation if working under a cost-type contract? Pro and con arguments can be made for both types of contract. The answer to these questions, however, will depend to a large degree on the attitudes of the individuals monitoring and evaluating the contractor's performance.

While the moral hazard issue is important and should be considered when selecting a contract type for environmental restoration, it is not the only consideration. The fit of the contract with the unique aspects of environmental restoration will be even more important. The moral hazard issue will therefor be addressed only as it pertains to providing incentives to a contract once the contract type is selected.

IV. THE ENVIRONMENTAL RESTORATION PROBLEM

A. ENVIRONMENTAL AREA

Historically, NAVFAC has used some type of FFP contract to accomplish most of the responsibilities it is assigned. These responsibilities include maintenance of naval installations and the facilities on them, and the construction of new facilities through the Military Construction (MILCON) program. While cost-reimbursement contracts were used, they represented only a small portion of NAVFAC contracts.

New requirements and responsibilities for cleaning up environmental problems have now been added to NAVFAC's docket. The addition of the environmental restoration problem has required NAVFAC to look into contracting mechanisms different from those favored in the past. Many people have looked at the IR program as a simple construction problem. They therefore conclude that the best contracting mechanism would be the traditional FFP contract. While hazardous waste cleanups do include many activities which are fundamental to construction, there are also several unique features which make environmental remediation very different.

1. Unique features of Environmental Cleanup

There are five features which make work on environmental remediation different from the standard

construction projects with which NAVFAC has historically dealt. Each of these five unique features will be investigated here.

a. Uncertainties in the Scope of Work

The most difficult problem when dealing with environmental restoration is an inability to define the scope of work. This is due to the inherent uncertainties associated with toxic contamination. It is relatively easy to determine that a site is contaminated, but determining the extent of the contamination is another matter. Many toxic sites are either buried dumps or areas where some liquid contaminate has seeped or migrated through the ground. In these cases, the area requiring remedial action is at least partially underground. It is difficult to determine the nature, concentration, and extent of this underground contamination until it is actually excavated. Also, a dump site may contain dozens of different toxic materials, each of which has to be cleaned up using different methods. It is usually difficult and expensive to determine which of these materials exist until the contractor actually encounters them during the clean-up.

In order to accurately define the scope of a cleanup, repeated and extensive soil sampling and analysis would have to be carried out. These tests would be both expensive and require considerable delays. Even after extensive tests, there is no guarantee that some new material

or migration path will not be discovered once the remedial action is started. In the environmental restoration area, the nature of the uncertainties are unknown, but their existence is an accepted reality.

A good example of the uncertainties involved in environmental restoration has been the removal and cleanup of underground storage tanks. Thousands of these tanks, many over 50 years old, exist on government installations. Often, it is difficult to determine if the tanks are leaking or even what was originally stored in them. Borings³ can be taken in the surrounding soil to see if it is contaminated, but the results of these borings can only give a very rough idea of the extent of the contamination. The problem is that the plume of leaking toxins from an underground tank will take unpredictable paths based on the makeup of the soil and material under the surface. Another problem is that old underground tanks sometimes disintegrate as they are lifted out of the ground. There is no way of determining if this will occur until the tank is actually removed. For these reasons, it is often impossible to define the exact scope of a tank cleanup until the job is well underway.

Most areas in environmental restoration are similar to the underground tank problem in that it is impossible to define the scope and level of effort required until the job is

³ Borings are holes drilled in the soil to determine the nature and content of the material below the surface.

actually complete. From above ground, sites can look very similar. What is of interest, however, is located underground. This points out the problem faced in defining the scope of environmental restoration projects.

b. Changing Regulations

The regulations governing the cleanup of environmental contaminants have been changing at a breakneck pace. Within the decade the Navy has gone from being able to rely on sovereign immunity to being under the jurisdiction of all federal, state, and local environmental regulations. Even since DoD has had to comply with these regulations, the regulations themselves have changed. Old regulations have been made more stringent, and new regulations have been implemented which put more constraints on when, how, and to what extent toxic sites must be cleaned up. (Pawlisch, 1991) The constantly changing environmental legislation and regulatory climate also make it difficult to accurately estimate costs during the restoration process. If regulations change halfway through a study, or an actual cleanup, work may have to be stopped and redone in order to meet the new requirements.

c. New Information and Technology

Much of the change in regulatory requirements is the result of the rapid improvement in measurement technology in the area of toxic waste. As the ability to measure smaller

and smaller quantities of toxic materials increases, the regulations often change to make this the new standard for cleanup.

Technological advancements can also greatly assist in the actual cleanup effort. Remediation technology is continually developing and improving. As new information and techniques become available, the successful contractors will be those who are innovative and aggressive in implementing these items.

d. Different Areas Enforce Regulations to Different Degrees

Regulators may require two toxic sites, similar in many ways but located in different areas, to be cleaned up to different standards based on the location of the site. (Pawlisch, 1991) This is understandable to a certain degree. You would expect a populated site in Orange County or San Diego, to be cleaned up more completely than a similar site located in Twenty Nine Palms or Yuma, AZ. Intangibles like this can not be included in a contract, however.

e. Different Regulators Will Emphasize and Enforce Regulations to Different Degrees

Even within the same organization and geographic area, individual regulators will have different personalities and emphasize and require different items. (Pawlisch, 1991) Within a local EPA office, certain individuals will have

different backgrounds and different levels of expertise. One regulator might have a background in water quality and therefore stress that aspect of an environmental cleanup plan. The regulator at the next desk may have a background in soils, and emphasize that area while almost ignoring the water quality aspects of the job. There is no way of predicting which regulator will review and approve any particular plan or design. Since these regulators have the authority to reject proposed alternatives or require unexpected revisions, it is important to recognize the uncertainty they introduce. This again, however, is an intangible which is difficult to predict and put in a contract.

2. Unique Features and Contract Type

The five issues raised above highlight some of the major differences between environmental restoration work and typical construction. All five represent some form of uncertainty which makes it difficult or impossible to accurately estimate costs or even the level of effort that will be required.

The uncertainties and possible contingencies in environmental restoration are numerous. The exact nature, extent of work required, regulatory requirements, and technologies available can not be predicted at the time of contracting. The cost of trying to anticipate each one of these items and including it in the contract would be

prohibitive. There is a point where the uncertainties are so great, and the probability of any particular event so small, that it is better to leave the contract vague and agree to price after the uncertainties are resolved. (The New Palgrave, 1987, pg. 549) This is exactly what a cost-reimbursement contract does.

If a FFP contract were used, the contractor would assume the entire cost risk of performance. He would therefore base his estimate on a worst case scenario and bid accordingly. The bid price would reflect a huge risk premium to compensate the contractor for assuming the cost risk of performance. This would not be a problem if using a cost-reimbursement contract because the government would pay for only the level of effort actually required. Only those uncertainties, contingencies, and regulations which are actually encountered or required will be included in the contract price. This should result in lower costs under a cost-reimbursement contract, as compared to FFP, because possible contingencies will not be included in a bid, and will not be included in the contract price unless they are actually encountered.

Another major disadvantage of using a FFP contract for the engineering work involved in environmental restoration would be the exorbitant number of contract modifications. It has already been established that the uncertainties can not be determined when writing the contract, and would therefore have

to be left out. This would mean that a contract modification would have to be negotiated each time an uncertainty or changed condition was encountered.

Contract modifications have a number of drawbacks. There are financial, administrative, and time costs with almost all modifications. They are extremely time consuming for both the government and the contractor. Work is often stopped until the problem area can be investigated, the scope and price negotiated, and direction provided to the contractor. Until the contract is officially modified, the contractor can not legally proceed with the changed work. This takes administrative effort and can substantially delay a project.

Another serious problem with contract modifications is the lack of competition. When an unforeseen site condition surfaces after contract award, the contractor is the sole source for resolving the problem. This can lead to many ramifications, one of the most serious being that the contractor no longer has any motivation to provide competitive prices for the work covered by the modification. In the environmental restoration area, where there is little question there will be unforeseen conditions encountered, the problems associated with contract modifications must be seriously considered.

A cost-reimbursement contract has the advantage that if uncertainties do surface, the contractor can be given

immediate direction on how to proceed. Work does not have to stop and the administrative, financial, and time costs of a contract modification can be avoided.

The use of a FFP contract would not only increase the number of contract modifications, it would also increase the number of contractor claims. The courts are full of claims filled against the government under FFP contracts. FFP contracts consistently comprise approximately 80 percent of all contract types submitted for claim with The Armed Services Board of Contract Appeals (ASBCA). (Ashhurst, 1983, p. 3) The leading contract issue in these claims involves the Changes clause. This is the same clause that would most likely to be used whenever uncertainties were encountered during the environmental restoration process.

It is easy to see how an area as ambiguous as environmental restoration would generate an even greater number of claims if a FFP contract was used. Cost-reimbursement contracts, on the other hand, rarely result in litigation. Since the government agrees from the start to pay all costs incurred, there is no need for the contractor to make claims for payment.

A cost-reimbursement contract would also allow the contractor to be much more flexible. If regulations changed, as they have been, a cost-reimbursement contract would allow the contractor to immediately, and with minimal cost, redirect his effort towards satisfying the new regulations. If a FFP

contract were used, the government would still pay for any new requirements, as well as the costs of contract modifications.

Innovation could also be encouraged through the use of a cost-type contract. This has definite advantages given the rapid improvement in clean-up technology. With cost-type contracts the government could encourage, or even direct, the contractor to be innovative with these new technologies. If the entire cost risk of performance rests on the contractor, as with FFP contracts, he will be hesitant to experiment with new technologies until they are proven. In the long run, this will hurt the government.

a. Conclusions Concerning Contract Type

Due to the uncertain scope and price conditions inherent in environmental restoration, especially up through the design phase, the use of some form of cost-reimbursement contract is clearly warranted. In situations with these major uncertainties, a FFP contract would not be appropriate, and would simply not fit.

If a FFP contract was forced in this situation, it would have to be written in one of two ways. It would have either a broad scope of work making the contractor responsible for all uncertainties, or a scope which ignored them. If the first option was used, the bids submitted would reflect many, if not all, of the uncertainties which might be encountered. Since contractors are considered risk averters, they would

submit bids based on the worst case scenario. Since rarely would all the uncertainties occur on one job, the government would be overpaying for the work.

If the second option was used, the government would have to pay for only those uncertainties which did actually surface. Each one, however, would result in a contract modification. This is an expensive and inefficient method of contracting for work.

The underground, regulatory, and technological uncertainties of the environmental area make it a perfect candidate for the cost-reimbursement contract. This is an area where the government should assume the cost risk of performance. Use of a cost-reimbursement contract in this area should be less expensive and also speed by years the cleanup effort.

V. COST-REIMBURSEMENT CONTRACTS

A. TYPES OF COST-REIMBURSEMENT CONTRACTS

There are five types of cost-reimbursement contracts. Each of these will be discussed below. It should be noted that there is no mention of a cost-plus-percentage-of-cost contract. It is obvious that this type contract would provide no incentive to minimize costs, and in fact would actually provide a strong incentive to increase costs in an effort to increase profits. The use of a cost-plus-a-percentage-of-cost contract has therefor been strictly prohibited by the FAR since World War I.

1. Cost Contract

With a cost contract, the government reimburses the contractor for all allowable and allocable costs up to the funding limit of the contract. There is no fee paid to the contractor in a cost contract.

This type cost contract is used primarily for non-profit educational institutions or facilities contracts. Facilities contracts are contracts under which government property is provided to the contractor for his use while performing the contract work.

2. Cost-Sharing Contract

Under a cost-sharing contract the contractor agrees to work for no fee and for only a portion of the costs incurred. A contractor would be willing to enter into an agreement of this nature if he felt he would derive some benefit by doing the work. This might be the case with an educational institution or a company that feels there will be an application for the product in the private sector.

3. Cost-Plus-Fixed-Fee Contract

The cost-plus-fixed-fee (CPFF) contract allows the contractor to be reimbursed for all allowable costs and a negotiated fee. The fee is agreed upon before the contract is signed and does not vary with actual costs. The fee can, however, be adjusted as the result of changes in the scope of the contract.

Because the fee is fixed and does not vary with the contractor's performance, there is little incentive for the contractor to control costs. The CPFF contract should therefore be avoided if possible and only be used when uncertainties involved in the work are so great that the level of effort required can not be nailed down and the contractor would not otherwise accept the risk.

It must also be impracticable to evaluate the contractor's performance based on subjective measures. If subjective measurement of contractor performance can be

obtained, a cost-plus-award-fee contract is a better mechanism for enticing the contractor to control costs.

There are two forms of the CPFF contract; completion and term.

a. Completion

The completion form directs the contractor to perform a task. The contractor provides his best effort in attempting to provide the product or service until the contract is satisfied or all authorized funds have been spent. If the work is not completed, the government has the right to increase the estimated cost of the contract, and to direct the contractor to continue work without increasing the fee.

b. Term

The term form (also called level-of-effort) directs the contractor to provide a certain level of effort for a specified time. The fee is paid to the contractor at the end of the time period. To get the fee, the contractor only has to show that he exerted the level of effort specified in the contract. The government does not have the right to direct the contractor to continue work under the term form. If the government desires additional work, a new contract must be negotiated with an additional fee. For this reason, the completion form is preferred over the term form.

4. Cost-Plus-Award-Fee Contract

A cost-plus-award-fee (CPAF) contract provides for the reimbursement of all allowable costs, plus a fee. The fee consists of two separate parts. The first is the base fee which is a fixed amount set at the inception of the contract. The base fee can range from zero to the regulatory limit of three percent. The contractor is entitled to the base fee portion of the award fee regardless of performance.

The second portion of the award fee is called the award fee pool and is earned by the contractor during the life of the contract. The amount of the award fee pool will vary, but it should be sufficient to motivate the contractor. It is limited only by the statutory regulations which limit the maximum fee (base fee plus award fee pool) to 15 percent of the estimated costs for experimental, developmental, or research work and 10 percent for other work. The award fee pool represents an additional fee available to reward the contractor for performance above minimum standards. In this way, it transforms the CPAF contract into an incentive contract.

The amount of the award fee pool given to the contractor is determined by a subjective evaluation by the government based on criteria contained in the contract. The performance criteria will be different for each contract. The important point is to provide criteria which will motivate the contractor to be efficient. The government is the sole judge

of how much of the award fee pool is given to the contractor. The contractor has no legal recourse if he does not agree with the amount.

5. Cost-Plus-Incentive-Fee Contracts

The cost-plus-incentive-fee (CPIF) contract provides for an initially negotiated fee which is adjusted up or down with a formula based on the relationship between actual total and targeted costs. After the contract work is performed, the fee is determined by use of the formula. The fee will be higher than the target fee if total costs are lower than target costs. Conversely, the fee will be lower than the target fee if total costs are above the target costs.

This type of contract is only appropriate if the criteria used to determine the incentive fee can be measured objectively. This will usually apply to hardware type contracts, since measurement of services can rarely be done objectively. The government must ensure that it knows what to measure, how to measure it, and if the formula works to encourage the desired behavior from the contractor.

B. WHICH TYPE OF COST-REIMBURSEMENT CONTRACT SHOULD BE USED FOR ENVIRONMENTAL RESTORATION?

Because a primary concern when using cost-reimbursement contracts is how to best encourage cost conscious behavior by the contractor, this should be one of the primary considerations when picking the form of cost-plus contract.

The basic cost contract, the cost sharing contract, and the CPFF contract all provide either no fee or a pre-determined fixed fee. It should be obvious that there is little the government could do under any of these contracts, other than threaten termination, which would provide a real incentive for the contractor to control costs. These contracts are therefore not appropriate for the huge environmental restoration problem.

This leaves the two incentive type cost-reimbursement contracts, the CPAF and CPIF. Both encourage some degree of cost consciousness from the contractor. The critical difference in this case is in how the fee is provided.

Under the CPIF contract, the fee is determined using a negotiated fee which is adjusted up or down by applying a formula which relates actual and targeted costs. A major justification for the use of cost-type contracts for environmental services, however, was that accurate cost estimates could not be obtained.

In the environmental restoration field, the relationship between actual and targeted cost may or may not reflect the quality of the contractor's performance. When dealing with the uncertainties discussed earlier, a project could easily come in well over the initial estimate. This does not necessarily mean that the contractor did not do a good job. In fact, a project could overrun its budget as a result of

unexpected problems even if a contractor was doing an outstanding job of controlling costs. Under a CPIF contract, this contractor would actually be penalized.

An incentive will only be effective if the contractor believes that his performance will influence the amount of his fee. This would not be the case if the CPIF contract was used for providing environmental services. The CPIF contract requires objective performance measures to be effective in motivating the contractor. Because of the lack of objective performance measurements in the environmental restoration field and the fact that services are generally hard to measure objectively, the CPIF contract would not be appropriate for an area as ambiguous as environmental restoration.

The CPAF contract is designed to reward outstanding contractor performance based on subjective evaluations by those monitoring the job. It is therefore the cost-type contract best suited to provide a real incentive for the contractor working in the environmental area. Since the contractor knows the amount of the award fee pool he receives will be based on the subjective evaluation, he will endeavor to excel in those areas being evaluated. If the evaluation criteria include quality, timeliness, technical ingenuity, and cost-effective management, these are the things the contractor will work to optimize. In this way the award fee pool, none of which is guaranteed to the contractor, will act as a real incentive for excellence.

For the reasons just discussed, the CPAF contract is the best suited for the engineering services required for environmental restoration. It both fits the unique nature of this problem and provides the best chance of maximizing the utility of the dollars spent in this area.

VI. ANALYSIS

A. NAVFAC'S DECISION

The advantages of a cost-reimbursement contract for the engineering services needed for environmental restoration were discussed in Chapter IV. Chapter V explained why the CPAF contract is the best form of cost-type contract for this work. NAVFAC evaluated this information, from many sources, and came to the same conclusions in 1988. (Telephone Conversation with Griffin, 23 August 1991) At that time, they made the decision to develop the long term CPAF contract, now called CLEAN, for the majority of the engineering and design services the Navy would need for environmental restoration during the 1990's.

There were other considerations that played in NAVFAC's decision to use these long term CPAF contracts. A long term cost-reimbursement contract provides some distinct advantages. Three of these advantages are discussed below.

1. CONTINUITY

A long term cost reimbursement contract for environmental restoration has several advantages. It is more economical to keep the same contractor on board rather than re-educate another. In fact, NAVFAC found that prior to use of CLEAN, the government was paying for multiple studies on the same area because different contractors were being used.

(Griffin, 1991, p. 7) If one contractor could be used under a cost-reimbursement contract, a considerable amount of duplication of effort could be avoided.

Working with the same contractor throughout a project would also allow cradle to grave engineering services with one firm. This would pin point liability, avoid the complications of work handoffs between contractors, and save considerable time and effort due to resolicitation between phases. These advantages alone will result in considerable administrative and cost savings while also avoiding years of bureaucratic delays.

Continuity would also help with the regulatory process. (Zagrobelny, 1991, p. 26) Continued contact between one contractor and the different regulatory agencies can expedite the regulatory process. This avoids continual repetition of the learning curve when dealing with bureaucratic organizations, and, once contacts are established, work should proceed more smoothly.

2. CONTRACTOR SELECTION

The use of a long term cost-reimbursement contract for environmental restoration would also be much more attractive to larger and more capable contractors. Until recently, the largest and most experienced full service environmental contracting firms have not been interested in DoD work. (Bechtel, 1991, p. 1) One of the primary reasons was that

they did not think that the rewards outweighed the risks. Unless long term cost-plus contracts are utilized for DoD environmental restoration, the government will have to settle for smaller firms with limited experience and competence and virtually no financial depth. (Bechtel, 1991, p.1) In the long run, this will cost more and result in an inferior finished product.

3. FLEXIBILITY AND RESPONSIVENESS

A long term cost-reimbursement contract would greatly increase flexibility in the environmental area. As discussed above, this type of contract might attract a much larger and more capable contractor. These large contractors are the only ones in the field with the full spectrum of environmental services which will be required throughout the restoration process.

It has been asserted that each site will be different and somewhat unique. A large contractor with a full spectrum of services will be able to quickly and efficiently handle the unique aspects of each job. Concurrently, however, use of the same contractor will allow him to apply lessons learned from earlier projects which did have similarities. These lessons learned would be with both the actual field work and the regulatory process.

The use of a long term CPAF contract may also make the contractor much more responsive. Contractors working under a

cost-type contract are typically more conscientious about meeting basic contract requirements and more cooperative and timely in responding to contractual direction. (Ballistic Missile Defense Organization, 1984, p. 6) The government would have more control over contractor effort and be able to take immediate action to make the contractor more cost effective. This would have a considerable impact on responsiveness and help make any critical cleanup more timely. In emergency situations, the existence of a standing contract, with a responsive and capable contractor, would provide a great benefit. Having immediate access to a contractor capable of providing quick response remediation could easily prevent a small spill from developing into a large and costly one.

B. THE MORAL HAZARD ISSUE

As explained in Chapter III, there is a moral hazard issue which must be addressed when dealing with cost-reimbursement contracts. The problem is in how to provide incentives in the contract which will overcome the moral hazard problem inherent in a principle-agent relationship which insulates the contractor (agent) from the risks of sub-standard performance.

The nature and unique features involved with engineering services in the environmental restoration area requires the risk sharing relationship provided by a cost-reimbursement contract. This same risk sharing relationship, however, is

exactly what insulates the contractor from his own sub-standard performance. The question, therefor, is how to encourage the contractor to act in a cost conscious and responsible manner. While individuals within NAVFAC may not have specifically addressed the issue of "moral hazard" when they developed the CLEAN contract, they were well aware of the incentive problem. CPAF contracts, and more specifically the CLEAN contracts, are structured to provide the proper incentives to the contractor.

There are three ways in which the CLEAN contract specifically counters the potential moral hazard problem.

1. Award Fee Pool

The most obvious incentive for the contractor is the award fee pool. The contractor will receive all, part, or none of the award fee pool based on a subjective evaluation by the government. The criteria used to evaluate the contractor are contained in the contract and are designed to encourage quality, timeliness, ingenuity, and cost effectiveness. (Telephone conversation with Griffin, 23 August 1991) As long as the contractor believes that his performance will affect the amount of the award fee pool he receives, he will be motivated to excel in the areas targeted by the performance criteria.

Technical monitoring is critical to the success of the incentive behind the award fee pool. Technical monitoring is

the only way the government can determine the quality of the contractor's performance. It is impossible for a contracting officer or financial analyst sitting back in an office to evaluate contractor performance. The fact that a job overruns is no indication of poor contractor performance. If it was, there would be little justification for the use of a cost-type contract in the first place. Only technical monitoring of the contractor can provide the evaluation needed to encourage desired behavior.

Take, for example, the situation where the contractor is drilling test wells during a remedial investigation. If the average depth of wells has been approximately 150 feet, a cost conscious contractor should attempt to utilize the smallest rig capable of getting the job done.⁴ If the contractor takes a 200 foot rig to the site and does not hit water by 200 feet, he will have to demobilize the rig, bring out a larger one, and remobilize it to finish the job. This, however, does not necessarily imply that the contractor used bad judgement. If only five percent of the wells are deeper than 200 feet, it would not be cost effective to bring a 300 foot drill rig to every job.

⁴Transportation and mobilization of larger drilling equipment, capable of going deeper into the ground, is significantly more expensive. A cost conscious contractor should weigh the cost of each size rig with the expected depth of the well.

The contractor in the above situation should not be penalized for not hitting water by 200 feet. Technical monitoring in the field is the only way to evaluate the job the contractor does in this situation. A financial analyst might look at the overrun caused by the transportation and mobilization of two drilling rigs as an indication of poor cost control. Technical monitoring, on the other hand, might show that the contractor did an outstanding job controlling costs once the unforeseeable condition was encountered, and actually prevented an even greater overrun. In this case, the contractor should be given a large portion of the award fee pool, and not penalized for the overrun itself.

This point is important because for any incentive to work as intended, the contractor must believe that his actions will affect his profit. If the contractor in the above example felt that his performance was going to be based solely on the cost of the job relative to the estimate, he would estimate and take the largest rig possible to every job site. It should be obvious that in that situation, the government would be overpaying for the majority of wells and cost efficiency would not be encouraged.

2. Option Years

The second way the CLEAN contract attempts to counter moral hazard is with the use of option years. The contractor is guaranteed only one year of work, with the nine option

years available if the Navy finds them desirable. The Navy can terminate the contract at any time after the first year by not exercising the next option year. The fact that each CLEAN has an estimated value of between \$100 and \$130 million should motivate the contractor to perform in a way that will ensure the Navy exercises each of the nine option years.

In order for the option years to serve as a motivation for efficient and effective performance, however, they must provide the contractor with adequate compensation possibilities. While \$130 million is a large sum of money, the contractor is more concerned with his own return or profit. Contractors are not in the business to simply turn money. They want to make a profit. Each option year must therefore provide the contractor with an opportunity to obtain a satisfactory level of profit. This means that the total award fee must be high enough to motivate the contractor. If the contractor does not feel that the profit he is obtaining from the CLEAN contract is adequate, he will not be motivated to encourage the Navy to exercise the next option year. If cost efficiency is a performance criteria the Navy is using to decide if the next option year should be exercised, the contractor will make no effort in this area.

An important consideration when evaluating the level of compensation which will motivate the contractor is the competitive nature of the environmental field today. Due to the rapid increase in emphasis on environmental compliance,

the market has not been able to keep up with demand for professionals trained in this field. There is an unmet demand for competent environmental services for all phases in the restoration process. Many private business and state agencies are also bidding for the services of the limited personnel and firms trained in environmental restoration. This means that if the compensation the CLEAN is providing contractors is not just fair, but also comparable to that available from other sources, the contractor will not be motivated to encourage exercising of the option years.

3. Performance Evaluations

The last means by which the CLEAN counters the moral hazard problem is through the use of performance evaluations which are placed into a nation wide data base. (Telephone conversation with Griffin, 23 August 1991) This data base can be accessed by all of DoD as well as any federal, state, and local government agency which is considering environmental work. If this data base is used as planned, it will provide a considerable incentive to contractors. There will be a large number of agencies querying the data base for contractor evaluations before they make contract awards. This will provide a real incentive for contractors to ensure only good evaluations are even put in the system. Contractors will do this be trying to excel in the areas the government feels are important; which is the goal of the incentive.

This is another area where market forces (the shortage of qualified firms and personnel in this field) could undermine the benefits of this incentive. If contractors perceive the demand for services as far exceeding the supply, some may be less concerned with the evaluations they do get. Considering the wide range of agencies using this data base, however, it can be assumed that it will provide a significant incentive for above average contractor performance.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

From the discussion and analysis in this thesis, it appears that NAVFAC made the correct decision in developing the CLEAN contracts utilizing long term CPAF contracts. Work in the environmental restoration field, especially in the engineering and design phases, encompasses a wide variety of activities which do not lend themselves to the traditional forms of contracting used by NAVFAC.

The inability to accurately define the scope and price of work in environmental restoration requires the use of some form of cost-reimbursement contract. Trying to make FFP contracts fit in this area would have many negative ramifications. Three of the most serious would be more expensive contracts, smaller and less capable contractors willing to accept the risk, and a large increase in contract modifications and litigations. This conclusion is made without the benefit of an actual cost-benefit analysis. It is, however, based on a detailed study of the unique nature of the environmental restoration field.

NAVFAC's choice of the CPAF contract provides an excellent balance between the risk sharing arrangement and the incentives for outstanding performance by the contractor. It

does this by addressing the moral hazard/incentive problem inherent in cost-reimbursement contracts. The award fee and the way it is earned by the contractor provides a very strong incentive for above average performance. In addition, the nine option years and the performance evaluation data base provide two other strong incentives to perform in the best interests of the government.

Overall, the CPAF contract appears to do an outstanding job of protecting the contractor from risks he would not, and should not, be expected to assume. At the same time, however, it provides a very good set of incentives to motivate the contractor to perform in a way that is both economical and in the best interests of the government.

B. RECOMMENDATIONS

The CLEAN contract seems to be well suited for both the unique aspects of environmental remediation and the concerns contractors have about risk in this new and developing field. The contracting question has been addressed and answered. There remains, however, one aspect that is crucial to the success of every CLEAN contract which has been awarded. That item is technical monitoring and the role it plays in the evaluation of the contractor. Complete monitoring is impossible due to financial and personnel restrictions. It must always be remembered, however, that no single action will reduce information asymmetry as much as technical monitoring

of the contract. Reducing this information asymmetry will do more than any other single action in controlling the moral hazard problem.

The incentives built into the CPAF contracts will be almost useless if the government does not use technical monitoring as the powerful tool it is. All three of the incentive measures built into the CLEAN require a technical, and not just financial, evaluation of the contractor's performance. If the contractor ever feels that they are being evaluated on simply the relationship between the estimated cost, which is a rough guess, and the actual costs, then overall quality, technical ingenuity, timeliness, and cost-efficient management will all suffer. It is critical for the government to recognize this fact and provide the assets needed to properly monitor the work while it is underway.

C. AREAS FOR FURTHER STUDY

The question of moral hazard, how it can effect a cost-reimbursement contract, and how to provide incentives in these contracts have all been only briefly covered in this thesis. Extensive additional study could be undertaken in any one of the above areas.

The moral hazard effect associated with the different types of contract is another area for additional study. The question of contractor motivation, with imperfect information, under different contract types was mentioned. A more in-depth

study of this question and the moral hazard/incentive issue would be useful in this area.

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